1. This is a drawing of sugar maple, *Acer saccharum*. In the table below, indicate five vegetative characters and five associated vegetative character states associated with its leaves that can be seen on this image. [1 point for each correct character and character state; no half points given. 5 points total]

<table>
<thead>
<tr>
<th>Vegetative Character</th>
<th>Character State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf Complexity</td>
<td>Simple</td>
</tr>
<tr>
<td>Leaf Attachment</td>
<td>Petiolate</td>
</tr>
<tr>
<td>Leaf Arrangement</td>
<td>Opposite</td>
</tr>
<tr>
<td>Leaf Venation</td>
<td>Palmate</td>
</tr>
<tr>
<td>Leaf Persistence</td>
<td>Deciduous</td>
</tr>
<tr>
<td>Leaf Margin or Leaf Blade Shape</td>
<td>Palmately Labeled</td>
</tr>
<tr>
<td>Leaf Lobe Apex</td>
<td>Acute or Acuminate</td>
</tr>
<tr>
<td>Leaf Surface</td>
<td>Glabrous</td>
</tr>
<tr>
<td>Leaf Base</td>
<td>Cordate / obtuse</td>
</tr>
</tbody>
</table>

**Any 5!**
2. Consider the Linnaean hierarchical system of classification for *Acer saccharum* Marshall and fill in the blanks with either the name of the category or the name of the taxon. **Hint:** Consider *Acer* to be a "dicot." To obtain the point for each category, the name must be spelled correctly and be in the proper format (i.e., underline, if necessary). [5 points]

<table>
<thead>
<tr>
<th>Name of Category</th>
<th>Name of Taxon</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Phylum or Division</td>
<td>Magnoliophyta</td>
</tr>
<tr>
<td>(ii) Class</td>
<td>Magnoliopsida</td>
</tr>
<tr>
<td>(iii) Order</td>
<td>Sapindales</td>
</tr>
<tr>
<td>(iv) Family</td>
<td>Sapindaceae</td>
</tr>
<tr>
<td>(v) Species</td>
<td><em>Acer saccharum</em></td>
</tr>
</tbody>
</table>

3. The genus *Acer* (maple) has traditionally been treated in its own family, Aceraceae (the maple family). However, recent phylogenetic studies have now placed it in the primarily tropical family Sapindaceae (soapberry family) along with *Aesculus* of the Hippocastanaceae (horse chestnut family). Currently, four subfamilies are recognized in the Sapindaceae (-oideae endings). Their relationships, and the number of species comprising each taxon, are presented in the cladogram below. Answer the following three questions.

- **See Lecture Activity #7.**

(i) Why is *Acer* no longer treated in its own family, Aceraceae? [2 points]
   
   **It arises within a paraphyletic Sapindaceae, and since each family should be monophyletic the Sapindaceae are circumscribed to include Aceraceae.**

(ii) What change to the above classification would you suggest in order that *Acer* be recognized again in the family Aceraceae and *Aesculus* in the family Hippocastanaceae? [2 points]
   
   **Remove Xanthoceras from the Sapindaceae and recognize it in its own family.**
   
   (or, recognize all taxa at the familial level)

(iii) What is the purpose of an outgroup in a phylogenetic analysis? [1 point]

   **It is used to polarize the character states, by rooting the phylogenetic tree.**
   
   **It is genealogically most closely related to the study group.**
4. Answer the following five questions on botanical nomenclature. [5 points]

(i) There are approximately 100 species of *Acer* (maple) most of which are native to Asia. Only one species is native to the Southern Hemisphere. While collecting in Myanmar you discover a new species of *Acer* and want to name it after its spreading flowers (the Latin word for spreading is *patens*). What is the complete scientific name of the species you have described?

\[ \text{Acer patens} \]

(ii) Satisfied with your accomplishment, you travel half a world away to South America for further collecting of your maples. There you discover a very similar plant, of the same species as that of Myanmar, with the only difference being its thicker, larger leaves. The Latin word for large leaves is *macrophyllus*. What scientific name and rank would you give this taxon?

\[ \text{Acer patens subsp. macrophyllus} \]

(iii) You bring your plants back home and you cultivate them in your greenhouse. While in cultivation, some plants produce velvety leaves. You propagate these plants and give them the cultivar name Plush Fantasy. Write out the full scientific name of this cultivar.

\[ \text{Acer patens 'Plush Fantasy' or} \\
\text{Acer patens cv. 'Plush Fantasy' or} \\
\text{Acer 'Plush Fantasy'} \]

(iv) The scientific name of your species in (i) above was published in the journal *Systematic Botany* in February 2014. To your absolute horror, you find that someone else described your very same species using the specific epithet of *palustris* (meaning, swamp growing), based on a plant discovered in China and published in a botanical work in 1736. Whose name has priority and why?

Priority of publication begins May 1, 1753 so any name published prior to this date is invalid. Often incorrectly answered.

(v) Just to make things worse, you discover the exact name of your species (in (i) above) was also given to a newly described dung beetle from Madagascar! The beetle’s name was published just two months before yours (December 2013) in the *Proceedings of the Madagascar Naturalist*. What implication does this have for the validity of your name?

None. Botanical nomenclature is independent of zoological nomenclature. Must include explanation.
5. Write the **complete floral formula** for a species having the following description (this is beard-tongue of the family Scrophulariaceae). [5 points]

Calyx herbaceous, connate and deeply 5-parted, zygomorphic; corolla trumpet-shaped, 5-merous, the tube much longer than the lobes, distinctly zygomorphic; fertile stamens 4, about as long as the tube, epipetalous; single style elongate, with 2 stigmas; insertion hypogynous; gynoecium syncarpous, fruit a septicidal capsule.

6. Identify the family represented by the species drawn below and write 4 diagnostic characters useful for its identification. [5 points]

**Family:** **Hamamelidaceae** - Spelling should be close. Latin name only.

(i) Anthers open by flaps  
(ii) Staminodes present  
(iii) Half-inferior ovary  
(iv) Woody loculicidal capsule

*Ideally, the features you list should be observable on this diagram.*

*Obovate, wavy, coarsely-toothed leaf margins*  
*4 linear petals*  
*Shrubs/trees*  
*Stellate hairs*  
*Syncarpous G of *F. cappelle*  
*Not just syncarpous G.*

*PLANT SYSTEMATICS, Third Edition, Figure 9.57*
7. (a) What three stresses are responsible for the formation and maintenance of the tallgrass prairie in Illinois? [3 points]

(i) Climate (extreme temps, periodic droughts)
(ii) Fire (natural causes or set purposefully)
(iii) Browsing (by insects or bison)

(b) What is meant by coefficient of conservatism? [1 point]

It is a measurement of floristic quality; a number from 1 to 10, where 1 = a species found anywhere and 10 = a species restricted to a high quality prairie.

(c) How much, by area, of the original prairie exists in Illinois today? [1 point]

0.011% (or \( \frac{11}{1000} \) of 1%)

(less than 1% is acceptable)

or 2,300 acres!

8. List five ways the number of carpels comprising a gynoecium can be determined. Not all will be necessarily present or equally useful in a given flower. [5 points]

(i) Count the # of stigmas or stigmatic lobes.

(ii) Count the # of styles. See Lecture Activity #4

(iii) Count the rows/intrusions of placentae

(iv) Count the number of locules

(v) Count the number of lobes (major bumps) on the ovary.
9. Illustrate (neatly!) each of the following. You must show all necessary critical features and label as necessary to avoid any ambiguity. [1 point each; 6 points total]

<table>
<thead>
<tr>
<th>Illustration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Leaf Diagram" /></td>
<td>A broadly obovate leaf with an oblique base and crenate leaves, like that of <em>Hamamelis</em></td>
</tr>
<tr>
<td><img src="image2" alt="Leaf Diagram" /></td>
<td>A pinnately compound leaf of 7 leaflets (showing position of axillary bud)</td>
</tr>
<tr>
<td><img src="image3" alt="Flower Diagram" /></td>
<td>A epigynous flower with a long hypanthium</td>
</tr>
<tr>
<td><img src="image4" alt="Flower Diagram" /></td>
<td>A X.S. of a syncarpous gynoecium showing axile placentation</td>
</tr>
<tr>
<td><img src="image5" alt="Flower Diagram" /></td>
<td>A L.S. through any flower showing adnation of corolla and androecium</td>
</tr>
<tr>
<td><img src="image6" alt="Flower Diagram" /></td>
<td>A L.S. through any imperfect flower</td>
</tr>
</tbody>
</table>

See Lecture Activity #3
10. *Prunus avium*, sweet cherry, is one of two cherry species which supply most of the world’s commercial cultivars of edible cherry (the other is wild cherry, *Prunus cerasus*). These flowers have a cup-shaped hypanthium, perigynous insertion, numerous stamens, and a monocarpous gynoecium. The fruit is a one-seeded drupe. Sketch (1) a L.S. of the flower and ovary and (2) a L.S. of the fruit and indicate (with labels) what part of the flower matures into what part of the fruit. [4 points]

![Image of a flower and fruit diagram]

11. The order Fagales comprises eight families, of which we have studied only two: Betulaceae and Fagaceae. The Balanopaceae (balanops family) also belongs to the Fagales and consists of a single genus (9 species) restricted to the southwestern Pacific (New Caledonia). Because phylogenetic classification systems are predictive, describe three features you might expect to see in the Balanopaceae based on what you already know about the Betulaceae and Fagaceae. [3 points]

(i) Trees or shrubs (woody plants)
(ii) Small, imperfect flowers G 2 or 3
(iii) Catkins

11. (a) List three (3) structural and/or evolutionary characteristics of the chloroplast genome that make it especially favorable for phylogenetic analyses? [3 points]

(i) Small, compact, circular genome
(ii) Smallest of the 3 genomes
(iii) Multicopy in cell
(iv) Clonally (uniparentally) inherited
(v) Structural rearrangements common
(vi) Regions with different rates of sequence evolution
13. The family Magnoliaceae (illustrated below), representative of the magnoliid clade, has retained a large number of angiosperm floral plesiomorphic features. **List four (4) of these floral features** (that must be seen in this image) in the spaces below. [4 points]

**Floral (or Fruit) Features Only.**

(A) (B) (C) (D) (E) (F) (G) (H) (I) (J) (K) (L) (M) (N) (O) (P)

**PLANT SYSTEMATICS, Third Edition, Figure 9.7**

(i) **Floral parts numerous and spirally arranged.**
(ii) **Laminar stamens**
(iii) **Apocarpous gynoeceum + marginal placentation**
(iv) **No adnation or connation**
    - Actinomorphic, perfect, hypogynous
    - Elongate, cone-shaped receptacle
    - Large, showy flowers
    - Aggregate fruit

TOTAL SCORE (out of 54): __________

There are 60 possible points, but the exam will be scored out of 54. Therefore, consider any 6 points (10% of the exam) BONUS!